

# MATERIAL SAFETY DATA SHEET

## 1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology  
Standard Reference Materials Program  
100 Bureau Drive, Stop 2320  
Gaithersburg, Maryland 20899-2320

SRM Number: 3121  
MSDS Number: 3121  
SRM Name: Gold Standard Solution

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**Description:** This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of gold. Each unit consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of gold. The addition of gold to hydrochloric acid forms gold chloride, which will precipitate upon evaporation or drying of the solution; thus, the mixture has three components.

**Material Name:** Gold Standard Solution

### Other Designations:

**Gold:** Au; aurum; gold metal

**Gold Chloride:** Auric chloride; gold trichloride; auric trichloride; gold (III) chloride.

**Hydrochloric acid:** Hydrogen chloride; hydrochloric acid, aqueous; muriatic acid.

## 2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Hydrochloric Acid	7647-01-0	231-595-7	10
Gold Chloride	13453-07-1	236-623-1	1.5
Gold	7440-57-5	231-165-9	1

**EC Classification, R/S Phrases:** Refer to Section 15, Regulatory Information.

## 3. HAZARDS IDENTIFICATION

**NFPA Ratings (Scale 0-4):** Health = 3      Fire = 0      Reactivity = 2

**Major Health Hazards:** Hydrochloric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Gold and gold chloride may cause irritation or allergic reactions.

**Physical Hazards:** The glass container may shatter. Protect from physical damage and heat.

### Potential Health Effects

<b>Inhalation:</b>	Inhalation of HCl may cause death due to inflammation, spasm, and edema of the larynx and bronchi. Chemical pneumonitis and pulmonary edema may occur. Symptoms of exposure include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Cyanosis and rapid breathing may occur. Exposure to gold or gold chloride may irritate the respiratory tract; gold chloride is a strong sensitizer.
<b>Skin Contact:</b>	Hydrochloric acid can cause severe burns, but it is not absorbed through the skin. Contact with gold causes allergic dermatitis in some individuals. Both gold and gold chloride may be absorbed through the skin.
<b>Eye Contact:</b>	Hydrochloric acid can cause severe burns and permanent eye damage. Gold dust can cause eye irritation or an allergic reaction.
<b>Ingestion:</b>	Hydrochloric acid can cause severe corrosive injury to the mucous membranes and GI tract. Internal bleeding may cause a drop in blood pressure. Other effects may include shock, metabolic acidosis, and circulatory collapse. Ingestion of gold or gold chloride can cause abdominal pain, nausea, vomiting, and diarrhea. The toxicity of gold chloride has not been fully investigated.

**Medical Conditions Aggravated by Exposure:** None documented for this mixture. Exposure may exacerbate any pre-existing condition affecting the skin, eyes, or other target organs.

### Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	_____	<u>  X  </u>
In the International Agency for Research on Cancer (IARC) Monographs	_____	<u>  X  </u>
By the Occupational Safety and Health Administration (OSHA)	_____	<u>  X  </u>

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## 4. FIRST AID MEASURES

**Inhalation:** Move the person to fresh air immediately. Qualified medical personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

**Skin Contact:** Remove contaminated clothing and shoes. Flush affected skin with water for at least 1 minute, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

**Eye Contact:** Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

**Ingestion:** Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

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## 5. FIRE FIGHTING MEASURES

**Fire and Explosion Hazards:** Hydrochloric acid is a negligible fire hazard when exposed to heat or flames. Hydrochloric acid may react with the evolution of heat on contact with water, and may release toxic, corrosive, flammable, or explosive gases. Hydrogen chloride gas is heavier than air and may accumulate in low areas. Gold chloride may react with ammonium salts to form explosive gold fulminate. Finely divided gold and a strong hydrogen peroxide solution may also explode.

**Extinguishing Media:** Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute hydrochloric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

**Fire Fighting:** Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

**Flash Point (°C):** N/A

**Autoignition (°C):** N/A

**Flammability Limits in Air:** N/A

**Lower Explosive Limit (LEL):** N/A

**Upper Explosive Limit (UEL):** N/A

**Flammability Class (OSHA):** N/A

**Products of Combustion:** Thermal decomposition of hydrochloric acid may release acid halides. Thermal decomposition of gold chloride may release acid halides and toxic chlorine gas.

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## 6. ACCIDENTAL RELEASE MEASURES

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**Occupational Release:** Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction. Empty containers may retain hazardous product residues. Do not flush to sewer.

**Disposal:** Refer to Section 13, Disposal Considerations.

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## 7. HANDLING AND STORAGE

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**Storage:** Store unopened containers of this material in a dry place with acid-resistant flooring at room temperature. Protect from physical damage, direct sunlight, heat, and incompatible materials.

**Safe Handling Precautions:** Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

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## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

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### Hydrochloric Acid:

ACGIH TLV-TWA: 2 ppm  
OSHA TLV-TWA: 5 ppm (7.6 mg/m<sup>3</sup>)  
OSHA PEL: 5 ppm (ceiling)  
NIOSH IDLH: 50 ppm

### Gold Chloride:

ACGIH TLV-TWA: None established; some sources recommend 1.0 mg/m<sup>3</sup>  
OSHA TLV-TWA: None established.

**Gold:**

ACGIH TLV-TWA: None established. Nuisance dust limits apply, but are unlikely to occur.

OSHA TLV-TWA: None established.

**Ventilation:** Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

**Respirator:** If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

**Eye Protection:** Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

**Personal Protection:** Wear appropriate gloves and protective clothing to prevent contact with skin.

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**9. PHYSICAL AND CHEMICAL PROPERTIES**

Hydrochloric Acid	Gold Chloride	Gold
<b>Appearance and Odor:</b> Colorless liquid; pungent, irritating odor (may be undetectable at PEL).	<b>Appearance and Odor:</b> Yellow to red hygroscopic crystals.	<b>Appearance and Odor:</b> Lustrous, yellow solid.
<b>Relative Molecular Weight:</b> 36.46	<b>Relative Molecular Weight:</b> 303.32	<b>Relative Atomic Weight:</b> 196.97
<b>Molecular Formula:</b> HCl	<b>Molecular Formula:</b> AuCl <sub>3</sub>	<b>Molecular Formula:</b> Au
<b>Specific Gravity:</b> 1.05 (10%)	<b>Specific Gravity:</b> 3.9	<b>Specific Gravity:</b> 19.31
<b>Solvent Solubility:</b> Soluble in alcohol and benzene	<b>Solvent Solubility:</b> Soluble in alcohol and ether; slightly soluble in ammonia.	<b>Solvent Solubility:</b> Soluble in aqua regia, hot sulfuric acid, and alkali cyanide solutions.
<b>Water Solubility:</b> Soluble, with slight evolution of heat	<b>Water Solubility:</b> Soluble	<b>Water Solubility:</b> Insoluble
<b>Boiling Point (°C):</b> 53 (127°F)	<b>Boiling Point (°C):</b> Decomposes	<b>Boiling Point (°C):</b> 2700 (4892°F)
<b>Melting Point (°C):</b> -74 (-101°F)	<b>Melting Point (°C):</b> 254 (489°F)	<b>Melting Point (°C):</b> 1064.76 (1948°F)
<b>Vapor Pressure (kPa):</b> 25 @25°C	<b>Vapor Pressure:</b> Negligible	<b>Vapor Pressure:</b> Negligible
<b>Vapor Density (Air=1):</b> N/A	<b>Vapor Density (Air=1):</b> 0.6	<b>Vapor Density (Air=1):</b> N/A
<b>Critical Solution Temperature:</b> N/A	<b>Critical Solution Temperature:</b> N/A	<b>Critical Solution Temperature:</b> N/A
<b>pH:</b> 1.0 (0.1M solution)	<b>pH:</b> N/A	<b>pH:</b> N/A

**NOTE:** The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of chromium, chromium nitrate, and nitric acid. The actual behavior of the solution may differ from the individual components.

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## 10. STABILITY AND REACTIVITY

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**Stability:**      X   Stable                   Unstable

Stable at normal temperatures and pressure.

**Conditions to Avoid:** Incompatible materials.

### Incompatible Materials:

Hydrochloric Acid: Incompatible with cyanides, metals, hydroxides, amines, bases, metal cyanides, oxidizing materials, acids, halocarbons, combustible materials, halogens, and metal salts.

Gold Chloride: Incompatible with ferrous sulfate, organics, ammonia gas, ammonium salts, amines, zinc, potassium cyanide.

Gold: Incompatible with hydrogen peroxide, ammonia gas, ammonium hydroxide.

**Fire/Explosion Information:** See Section 5.

**Hazardous Decomposition:** Thermal decomposition of hydrochloric acid may release acid halides. Thermal decomposition of gold chloride may release acid halides and chlorine.

**Hazardous Polymerization:**           Will Occur      X   Will Not Occur

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## 11. TOXICOLOGICAL INFORMATION

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**Route of Entry:**      X   Inhalation              X   Skin              X   Ingestion

### Hydrochloric Acid:

Human, inhalation, LC<sub>Lo</sub> (30 min): 1300 ppm  
Human, inhalation, LC<sub>Lo</sub> (5 min): 3000 ppm  
Woman, oral, LD<sub>LOW</sub>: 420 µL/kg

### Gold Chloride:

Rat, subcutaneous: TD<sub>Lo</sub> = 22 mg/kg

### Gold:

Rat, intravenous: LD<sub>Lo</sub> = 58 mg/kg

### Target Organ(s):

Hydrochloric Acid: lungs, upper respiratory tract, GI tract, skin, and teeth.

Gold and Gold Chloride: immune system (sensitizer), skin, respiratory tract, GI tract, kidneys, liver.

**Mutagen/Teratogen:** The reproductive effects of hydrochloric acid have not been fully investigated. Standard cell culture tests indicate that gold chloride is be a possible human mutagen. Gold chloride also adversely affects the reproductive tract of male rats.

**Health Effects:** See Section 3.

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## 12. ECOLOGICAL INFORMATION

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**Hydrochloric Acid:** When released to water, HCl is ionized. Neutralization depends on the buffer capacity of the water. In the atmosphere, HCl is absorbed in cloud droplets and transformed to Cl<sup>-</sup>, with a half-life of 5.5 days. The solubility of HCl indicates a high mobility in soil.

Bluegill (*Lepomis macrochirus*): LC<sub>50</sub> (96 hrs) = pH 3.5

Mosquitofish (*Gambusia affinis*): LC<sub>50</sub> (96 hrs) = 282,000 µg/L

Common Shrimp (*Crangon crangon*): LC<sub>50</sub> (48 hrs) = 260,000 µg/L

**Gold Chloride:** No ecotoxicity data were found for this specific compound.

**Gold:** Since gold metal is not water soluble, its bioavailability is limited. Also, large quantities of gold are seldom dumped into the environment.

**Environmental Summary:** The mixture is expected to be (at most) slightly toxic to aquatic life. The environmental effects of some components have not been fully evaluated.

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## 13. DISPOSAL CONSIDERATIONS

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**Waste Disposal:** One or more components of this mixture is a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

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## 14. TRANSPORTATION INFORMATION

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### U.S. DOT and IATA:

Hydrochloric Acid Solution: Hazard Class 8, UN1789, Packing Group II, Packing Inst. 809 (Excepted Qty)

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## 15. REGULATORY INFORMATION

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### U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Gold: Not regulated.

Gold Chloride: Not regulated.

Hydrochloric Acid: RQ = 5000 lbs.

SARA Title III Section 302: Hydrochloric acid is regulated in anhydrous or gas form only.

SARA Title III Section 304: Hydrochloric acid is regulated in anhydrous or gas form only.

SARA Title III Section 313: Hydrochloric acid is regulated in gas, anhydrous, or aerosol form only.

OSHA Process Safety (29 CFR 1910.119): Hydrochloric acid is regulated (TQ = 5000 lbs).

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: No

REACTIVE: Yes

SUDDEN RELEASE: No

### STATE REGULATIONS

California Proposition 65: Not regulated.

## CANADIAN REGULATIONS

WHMIS Classification:

Hydrochloric Acid: D1A (very toxic material), E (corrosive material)

Gold Chloride: D2B (material causing other toxic effects)

Gold: D2B (material causing other toxic effects)

WHMIS Ingredient Disclosure List: All three components are regulated.

CEPA Domestic Substances List (DSL): All three components are regulated.

## EUROPEAN REGULATIONS

EU/EC Classification:

Hydrochloric Acid: T (Toxic), C (Corrosive)

Gold Chloride: Xi (Irritant); not listed in Annex I of Directive 67/548/EEC.

Gold: XN (Harmful); not listed in Annex I of Directive 67/548/EEC.

Risk Phrases (mixture):

R23 (toxic by inhalation)

R25 (toxic if swallowed)

R35 (causes severe burns)

R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S26 (rinse and seek medical advice after contact with eyes)

S28 (wash after contact with skin)

S36/37/39 (wear suitable protective clothing)

S45 (in case of accident or illness, see doctor; show label)

## NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

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## 16. OTHER INFORMATION

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### Sources:

Amdur M.O., et al., *Casarett and Doull's Toxicology: The Basic Science of Poisons*. 4th Ed. New York: McGraw-Hill, 1993.

Hazardous Substances Data Bank (HSDB): Gold, Elemental, and Gold Compounds.

IUCLID Chemical Data Sheet: Hydrogen Chloride. European Chemicals Bureau, 19 February 2000.

PAN Pesticides Database: Hydrogen Chloride.

U.S. Agency for Toxic Substances and Disease Registry (ATSDR): Medical Management Guidelines for Hydrogen Chloride (HCl).

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, June 1990 edition. DHHS (NIOSH) Publication No. 90-117.

U.S. National Institute of Standards and Technology, *Certificate of Analysis: Standard Reference Material® 3121, Gold Standard Solution*. 2 June 2005.

**Disclaimer:** Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.